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PROBABLE TYPES OF DIFFICULTIES UNDERLYING LOW SCORES IN COMPREHENSION TESTS

BY

GEORGE HORATIO HILLIARD

PUBLISHED BY THE UNIVERSITY, IOWA CITY

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The following study was undertaken with the hope that it would be of value to those interested in silent reading problems, especially remedial work in silent reading.

The writer wishes to acknowledge his debt to all those who have made the study possible and for the guidance and kindly criticism given from time to time. He is especially indebted to Dr. Ernest Horn and Dean Carl E. Seashore for suggesting the problem. Dr. Horn was also generous in his suggestions and criticisms concerning the method used and in the development of the study from beginning to end. To Dr. Frederick B. Knight and Dr. Harry A. Greene credit is given for guidance in the statistical treatment of Chapter III and for other suggestions throughout the study. The writer is indebted also to the Iowa Child Welfare Research Station for the results of individual and group intelligence examinations given to the children of the University Elementary School.

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CHAPTER I

INTRODUCTION

The purpose of this study is to single out, so far as possible, the factors that are responsible for low scores on comprehension tests in silent reading and to group them in classes representing probable types of difficulty that underlie such scores. It seems that such a study will be helpful in suggesting types or fields of training that will improve faulty conditions. This study is to be one of status only; that is, the children used in the experiments were all at the same level of school experience and no attempt was made to follow up the tests by corrective measures. A study of such corrective measures would be an excellent problem for a sequel to this study.

METHODS USED IN THE STUDY

At least three methods of approach to the problem seemed practicable. One was to train specifically for the removal of factors thought detrimental by various experimenters and writers. By this method comprehension tests would be given at the beginning and the end of the period of training and the growth checked against that of another group of like ability, similarly tested, but not given the specific training in the interim. Such a study would give a very accurate measure of the influence of any one factor on general comprehension. Conditions prevented the author from using this method at this time.

A second method was to examine a number of answers to questions which were given as a test to determine the understanding of materials read. These answers, classified and studied critically, gave an insight into the cause of the difficulties underlying low scores or marks on these tests. Two studies have been valuable in suggesting this method.

Thorndike followed a similar method in his study on the understanding of sentences and paragraphs. When he examined the answers to questions covering the sentence or paragraph at hand, he found a wide spread in the ways the answers were given. He concludes that the reasons for wrong or inadequate reading are

(1) wrong connections with the words singly, (2) over-potency or under-potency of the elements, (3) failure to treat the ideas produced by the reading as provisional, and so to inspect and welcome or reject them as they appear.*

Dr. Greene measured comprehension by means of comprehension exercises that were based on logical, factual and related material. In these exercises the subjects were asked to indicate their understanding of the material read by the completion of some act, by the giving of some definite objective response which left a record. When he compiled the types of responses he found the different exercises showed astonishing variability. One of his conclusions follows: "Children read and glibly discuss certain content material placed in their hands, but when they are held strictly to account by an objective indication of comprehension, the scores made are startlingly low. Among the factors which may affect the results are: (a) silent reading ability; (b) geographical knowledge (this test dealt with geographical material); (c) mechanical features of the tests; (d) lack of motive on the part of the pupils." The method suggested by Greene for analysing the types of response was a valuable aid in approaching this phase of the problem at hand.†

In the preliminary development of this thesis a very extensive study of this kind was worked out by the author, using the answers to several tests given to the fifth grade of the University Elementary School, and the answers given by the University Freshmen to the Iowa Comprehension Test B1. While the details of this study were very interesting, the conclusions reached coincided so closely with those of Thorndike and with those hereafter presented by the author as a result of another method, that it was not thought worth while to include them in the final presentation of the thesis.

The third method, which was finally chosen for the basis of this study, was to make a careful and critical examination of the studies in silent reading that make suggestions as to the difficulties that underlie low comprehension, to select these difficulties and to designate them as possible types. Then, by giving tests that measure the ability of which these difficulties show a lack, one could correlate and compare the results in these tests with the

* Thorndike, E. L., "Reading as Reasoning", *Journal of Educational Psychology*, Vol. 8, 323-332.

† Greene, H. A., "Measuring Comprehension of Content Material." *The Twentieth Year Book of the National Society for the Study of Education.* Part II, pp. 114-126.

results of the comprehension tests. To find the influence of any one factor on comprehension, one has recourse to the method of Partial Coëfficients of Correlation, by which the relationship of two functions for a constant value of other functions can be determined, and to the method of Partial Regression Equations, by which the relative importance of each factor included in any ability can be measured. One hindrance presents itself here in the fact that for many of the difficulties suggested there are no available standardized tests. For instance, lip-reading and articulation have been said to be a hindrance to effective comprehension. As yet we do not have a test for lip-movements that will tell accurately the degree to which it exists. The best we can do is to say that the individual uses much, little, or none in his reading.

It seems to the writer that the above methods of approaching the problem are not antagonistic to one another. They represent avenues of approach to the same field from different angles, and the findings of one support and complement the findings of another. The results of all of them, taken together, may be useful in suggesting types of training for the elimination of comprehension disabilities so far as they can be eliminated.

MATERIALS USED IN THE STUDY

In the preliminary development of the problem, tests of various kinds were given in grades V to IX of the University of Iowa Elementary and High Schools, and the results tabulated. The results of certain tests given to the University Freshmen at the opening of the school year were accessible, as were also the delinquency reports of the various instructors with whom the freshmen were taking work. For the final tests on which Chapter III of the study was based, the fifth grade of the University Elementary School and the four groups of fifth grade pupils in the public schools of Cedar Rapids, Iowa, were selected.

In the study of analysis of answers two groups of students were chosen: (1) the fifth grade of the University Elementary School was given certain comprehension tests, and the answers were used for analysis; (2) the answers of the University Freshmen in a comprehension test given at the beginning of the school year were taken. Only the papers having a score of 25 percent or less were used, the number being ninety-four.

It was thought that grade V would show disabilities in com-

prehension at a period when silent reading was being emphasized, for which, if detected thus early in the school experiences of the children, corrective measures could be taken with maximum economy. On the other hand, the University Freshmen represent largely the product of our public schools and will show the extent to which comprehension disabilities persist, so far as our means of testing reveal them.

In the preliminary work, certain standard tests and others which seemed to meet the needs of the problem were used. After carefully checking the results of all these tests, the following, as being representative, were chosen for use in the final presentation of the study.*

1. Tests measuring comprehension
   a. Monroe Silent Reading Test
   b. Thordike-McCall Silent Reading Scale
   c. Burgess Scale for Measuring Reading Ability
   d. Courtis Silent Reading Test
2. Tests measuring special abilities
   a. Intelligence
      (1) Terman Group Intelligence Test
      (2) Terman Individual Intelligence Test
      (3) Otis Group Test
   b. Vocabulary
      (1) Thorndike Visual Vocabulary
      (2) Starch Vocabulary (modified form)
      (3) Vasey Vocabulary
      (4) A vocabulary test based on Monroe's Silent Reading Test
      (5) A vocabulary test based on The Dutch Homestead paragraph
   c. Organization
      (1) Greene English Organization Test
   d. Reproduction
      (1) Whipple Dutch Homestead
   e. Rate
      (1) Courtis Silent Reading Test
      (2) Monroe Silent Reading Test
      (3) Special tests devised by the writer
3. Tests given for the purpose of analyzing answers
   a. Thorndike-McCall Reading Scale
   b. Iowa Comprehension Test B1
   c. Four unstandardized tests based on subject matter used in grade V

* A complete file of these tests has been deposited in the Education Library, State University of Iowa.

CHAPTER II

SUGGESTED LIST OF DIFFICULTIES IN COMPREHENSION IN SILENT READING

The reader of educational literature bearing on the problem of silent reading frequently finds suggestions made as to the cause of faulty or immature ability in comprehension. Many of these suggestions are the conclusions drawn from experiments conducted in a scientific manner, and, so far as the data go, point to definite causes of low comprehension. Other suggestions are not the conclusion of carefully performed experiments, but rest upon certain psychological principles which seem to be fundamental.

It is the purpose of this chapter to make a survey of the field of reading and to make a list of suggested difficulties as they occur in the various studies. In other words, the chapter is offered as a summary of experimental studies and current thought concerning factors affecting low scores in comprehension tests. In no place in this study has the writer taken cognizance of such general factors as poor health, visual defects, or other conditions requiring medical attention.

In all, these suggested difficulties were grouped into twelve different types and each of these will be given attention hereafter together with whatever evidence is given by writers mentioning them.

SUGGESTED DIFFICULTIES

1. *Low General Intelligence*

Franzen, (8)* after working with the school children of Garden City, N. Y., concludes that disparity of school products can be reduced to individual differences in intelligence and that there is little specific inheritance of school abilities. This would include ability in comprehension in reading as well as other school subjects. Theisen (35) raises the question, "Does intelligence tell in first-grade reading?" He presented material in an effort to determine whether the reading attainments of different first-grade groups are at all closely related to their intelligence. He tested

* The numbers in parentheses refer to the bibliography found at the end of this chapter.

the intelligence of these groups by means of the Pressey primer scale and the reading ability by means of the Haggerty reading test for primary grades. The pupils were grouped in classes by means of the Pressey scores and teacher's estimates, and these classes were called bright, medium, and slow groups. The following table shows the comparative records of intelligence and reading scores of the classes that made up the bright, medium, and slow groups.

TABLE 1

READING SCORES OF THREE GROUPS OF PRIMARY PUPILS CLASSIFIED ON THE BASIS OF INTELLEGENCE

(After Theisen)

Group	Number of Classes	Number of Pupils	Median age of Pupils	Pressey Score	Haggerty Reading Score Test I	Test II
Bright	16	344	7 years 0 months	Above 55	8.8	5.7
Medium	18	331	7 years 2 months	40-55	5.7	2.8
Slow	17	317	7 years 1 month	Below 40	3.1	0.9
Total	51	992				
Average					5.9	3.1
Standard:						
Grade I					4.0	2.0
Grade II					12.0	6.0

Theisen offers the following conclusion: "We firmly believe that the results of this experiment are sufficient to warrant the adoption of a policy of grouping entering pupils wherever possible. New requirements should be set up which vary with the intelligence levels of the children. Promotions should be made to the corresponding group of the next higher grade and should be based upon successful completion of the work outlined for a group of a given level."

Dickson (7) separated the children of the low first grade on the basis of the intelligence quotient. After an experiment which lasted about a year and a half, he concludes that mental tests of several hundred first-grade children have shown that mental age and I.Q. are important factors in revealing a child's chances of success in school work, and that children who test low are very slow to learn to read. They have little initiative. What they appear to learn one day is not retained the next. Much drill and repetition are necessary. Their reading is marked by a tendency to name words without thought of the meaning.

Theisen quotes Haggerty (14) as having found a significant correlation between intelligence and ability to perform the exercises of his primary reading tests. The latter correlated teacher's estimates when weighted according to grade location with scores on his reading tests. In the case of 200 pupils in grades I-III the Pearson coëfficients were .71 for test I, .69 for test II, and .76 for the two tests combined. Similar figures for 144 eight-year-old pupils were .67, .67, and .71. With the scores obtained with his intelligence test, the figures were .63, .67, and .70 for the same group. For 200 pupils in grades I and II the intelligence and reading tests yielded a correlation of .84.

King (24) tested the pupils of the Iowa City High School by means of the Kansas Silent Reading Test, and then compared his results with the average class mark as a measure of general ability. The following table shows his results. In this table the class marks have the following values: E is excellent, G is good, M is medium, P is poor, and F is failure.

TABLE 2

AVERAGE CLASS MARKS AND COMPREHENSION SCORES (KANSAS SILENT READING TESTS) IOWA CITY HIGH SCHOOL

Average Class Mark	Median Comprehension Score
E	42.0
G	41.3
M	25.0
P	21.3
F	14.0

Theisen (36) found that when pupils of the VII-B grade of the Cleveland Junior High Schools were grouped according to scores earned on the Illinois Examination, the higher groups as determined by the intelligence test had the higher median comprehension score. The following table shows these comparative scores.

TABLE 3 (from Theisen)

MEDIAN CLASS SCORES BY INTELLIGENCE GROUPS

Illinois Intell. Test Score	Med. Score Intell.	No. Classes	Monroe Comprehension
82 and up	86	11	32.3
72 — 82	75	13	26.8
67 — 72	69	8	23.8
62 — 67	65	12	23.6
52 — 62	56	12	21.5
Below 52			

He found a positive correlation of .44 by the Pearson formula between scores on the Illinois Intelligence Examination and Monroe

Comprehension. In his conclusions Theisen says, "In presenting the results, we are not unmindful of the fact that success in school work depends not only upon intelligence but upon several other factors, among them being general maturity, previous scholarship, effort, home environment, attendance and health, the quality of teaching, the course of study. Naturally, a pupil who is highly favored in each of these respects will advance more rapidly than one who is unfortunate in each."

Gates (9) conducted an experiment during the school year 1920-21 in the Scarborough School, Scarborough, New York, in which he used a number of reading, vocabulary, and intelligence tests. In his investigations he used grades III-VIII inclusive. There were approximately 20 pupils in each grade. He found the following correlation between the Stanford Revision of the Binet Scale and a composite of several group intelligence tests, and the comprehension scores of several reading tests. The table below gives the mean of the grade correlations and the S. D.'s from the mean.

TABLE 4

MEAN GRADE CORRELATIONS AND S. D'.S FROM MEAN BETWEEN INTELLIGENCE AND COMPREHENSION AS MEASURED BY SEVERAL TESTS

(From Gates)

	Brown Comp.	Burgess	Courtis Comp.	Monroe Comp.	Thorndike McCall	Com. Comp.
Stanford M.A.—	.02	.33	.00	.24	.47	.34 r
	.26	.22	.29	.21	.19	.24S.D.
Comp. Group	.15	.57	.57	.38	.69	.69 r
Intel.	.16	.11	.15	.24	.09	.10S.D.

By studying these correlations one can see that those made with the individual test, Stanford Revision of the Binet are rather low. Only in one case, that of the Thorndike-McCall, is the correlation above .35. On the other hand, one notices that the correlations between the various comprehension tests and the composite of the group intelligence tests, with one exception, are all above .35. Gates concludes that "The results do not justify the conclusion that we have, in reading, a group of functions bound by some general factor."*

Thus from the evidence that we have summarized, it seems that

* The factor of pushing children to their capacity might enter to give different results from different writers. For example: Franzen says that he attempted this and in every case as his pupils were pushed nearer and nearer to their capacity as a limit his correlations between general intelligence and achievement in reading became nearer and nearer unity. Whether Gates' pupils at Scarborough were pushed to the limits of their capacity in reading, he does not state. If they were not, the fact might explain the difference between his conclusions and those of Franzen.

there is a divided opinion as to the influence of general intelligence as a factor in comprehension. From Franzen, who says that disparity in school product is a matter of individual differences in intelligence, to Gates, who says his results do not justify such a conclusion, we have rather a wide range of opinion. It seems that we are not clear as yet in our position as to just what place can be given to general intelligence as a factor in comprehension in silent reading. It seems that the above studies generally show that it is an important factor but only one among the causes of widely varying scores in comprehension tests.

2. *Vocabulary Limitations*

A second type of difficulty that is frequently mentioned by writers dealing with the problem of low comprehension is a limited vocabulary. Sholty (34) made a study of the reading vocabulary of pupils who had been in school one and one-half years. She asked the regular reading teacher to select three pupils from the class. A was the best reader, B was a medium reader, and C was the poorest reader in the judgment of the teacher. Sholty arranged alphabetically the vocabulary of all the readers used in the first grade. Each child read through all the books while Sholty noted the words he did not know. Then by means of the tachistoscope she found out the numbers of words known on the instant, and, finally, by giving as much time as needed the number of words each child was able to build up. She gave the following table showing her results.

TABLE 5

SHOWING THE COMPARISON OF THE VOCABULARIES OF THREE PUPILS: A, A GOOD READER; B, A MEDIUM READER; AND C, A POOR READER ACCORDING TO TEACHER'S ESTIMATE

	Total No. Wds.	No. Wds. Known in Context	No. Wds. Known on Instant	No. Wds. Built up	No. Wds. not Known
A	1588	1392	977	413	199
B	1588	1438	798	670	120
C	1588	1309	1009	315	264

There were probably too few cases in this study to draw definite conclusions from it. From the table presented, one sees that the pupil marked lowest in reading ability by the teacher is also lowest in word knowledge. On the other hand, the one marked best in reading ability is somewhat below the one marked medium when word knowledge is considered. There is need for a further elabora-

tion of this type of study, especially since we can take advantage of such scientific instruments as are at our disposal to-day for measuring comprehension.

Pressey and Pressey (30) in a critical study of the concept of silent reading include a large reading vocabulary and a background of information as one of four factors needed in the reformulation of silent reading problems. They say, "Evidently a reading vocabulary is the factor most readily acquired by reading. Measurement of vocabulary should, the writers feel, be a regular practice in appraising the work of a teacher or the school. By a curious and unfortunate circumstance, vocabulary tests have received most attention as measures of general intelligence. The acquirement of an adequate reading vocabulary, presumably by a large amount of required reading of a type in which the pupils are interested, would seem to the writers to be one to which the schools would give decided attention. In fact, they feel that this is the neglected element in the silent reading situation."

Anderson and Merton (2) mention inability to understand the meanings of words as a defect occurring in silent reading affecting comprehension. They say that meager vocabulary is the cause of 33% of the errors in silent reading.

Butt (5) took 108 students from the Madison, Wis., high school and divided them into two groups of equal ability as shown by previous scholarship grades and grades in English, French, and Latin. Then one group was given definite drill in word study by using Swinton's text, while the other received the regular training in sophomore composition and literature. Both groups were then tested by certain vocabulary and reading tests. The scores of the two groups on Thorndike Intelligence Examination 1a and 1b are given below. These tests are essentially reading tests. Group A is the word-study group and group B the non-word-study group.

TABLE 6

EFFECT OF DEFINITE WORD DRILL ON READING SCORES

(From Butt)

Tests	Group	Score	M.V.	P.E.	Diff.	P.E. of Differences
Thorndike 1a	A	6.4	3.8	.43	1.1	.73
	B	5.3	4.0	.60		
Thorndike 1b	A	5.3	4.0	.40	2.2	.51
	B	3.1	3.3	.32		

Butt's experiment, while indicative of the fact that word knowl-

edge enters into reading ability, hardly gives us the extent to which it does. A study of individual cases probably would reveal a considerable number of pupils in the non-word-study group who made greater gains than their respective equals in the word-study group. Had she been able to control conditions to a greater degree, the results of her training would probably have shown a greater difference between the two groups than is shown in Table 6. She concludes as follows: "The results as they stand in the table show that the word-study group has made a decided gain over the non-study group along the four lines for which we tested. The fact that the non-word-study group carried work in composition and literature makes the reading and language gains appear to be very substantial and adds to the sum total of transfer and gives a wholesome respect for the word study method of attack."

Thorndike (38) after testing a number of children in reading by means of paragraphs with questions covering them, gave as one of three causes of faulty or wrong answers, the fact that wrong connections were made with the words singly.

Gates (9) found a rather high correlation existing between vocabulary tests and comprehension scores made by the children of the Scarborough School. He used Holley's vocabulary test and a special test devised by himself. The following table shows the mean of the grade correlations with S. D.'s from the means.

TABLE 7

MEAN OF THE GRADE CORRELATIONS AND S. D.'S FROM THE MEAN BETWEEN VOCABULARY TESTS SCORES AND COMPREHENSION SCORES

(From Gates)

	Holley Vocab.		Special Vocab.	
	r	S.D.	r	S.D.
Brown Comp.	.03	.22	—.07	.16
Burgess	.54	.12	.65	.07
Courtis Comp.	.35	.21	.32	.16
Monroe Comp.	.52	.11	.58	.13
Thorndike-McCall	.57	.21	.51	.19

The fact that the classes with which he worked were small, renders his correlations less reliable than if they had been based on larger numbers. However, admitting this shortcoming, one is impressed by the significance of the correlations with the exception of the Brown comprehension with each of the vocabulary tests.

Hilliard (16) made a preliminary study of the relation of

vocabulary to reading ability of 165 pupils in the ninth grade of the Austin and Lindbloom High Schools of Chicago. To measure vocabulary Carr's Vocabulary Test was used. Reading ability was measured by the Thorndike-McCall Silent Reading Scale. These pupils had also been tested for general intelligence by the Illinois Intelligence Examination. The following table gives the results of his study.

TABLE 8

CORRELATIONS BETWEEN CARR'S VOCABULARY, ILLINOIS INTELLIGENCE EXAMINATION, AND THORNDIKE-MCCALL SILENT READING SCORES. 165 NINTH GRADE PUPILS, AUSTIN AND LINDBLOOM HIGH SCHOOLS. CHICAGO, 1921-1922

Abilities Correlated	r	P.E.
Thorndike-McCall and Carr Vocab.	.670	.029
Thorndike-McCall and Illinois Exam.	.545	.037
Carr Vocab. and Illinois Exam.	.596	.026

He then, by the method of Partial Correlations* found the correlation between vocabulary and reading, when intelligence was rendered constant, to be, "r" equals .511. His conclusion, based on these correlations, is that vocabulary is an important factor in silent reading ability.

A summary of the preceding studies reveals a general agreement that vocabulary is an important factor in comprehension although they approach the problem from different angles. The nearest approach to an experiment in which the actual relationship between these two abilities is shown, is that of Butt. If it is desirable to determine with the greatest possible accuracy this relationship, a number of similar experiments should be conducted in which every effort is made to control all conditions which would affect the results obtained. Comparisons between scores made on comprehension tests and vocabulary tests for a large number of individuals would also throw more light on the question.

3. *Faulty Rate of Reading*

Judd (20) concludes that in general, as shown by the Cleveland tests, good quality and rapid reading commonly go hand in hand. Poor quality and slow reading are in like manner commonly related. Referring to the following table he says, "These figures serve to emphasize the fact that good readers are usually not slow and poor readers are usually not fast. It is evidently not

* For an explanation of this method see Chapter III. The material for this study was collected by Mr. E. E. Keener, of the Department of Measurements of the Chicago Public Schools.

safe to attempt to lay down any absolute rule. There are good readers who are slow. In some cases such readers may be temperamentally slow. But even making allowance for such individual peculiarities, the figures show that good reading and slow reading are not incompatible. In like manner there are a certain number of children who read rapidly but retain little of what they read. With the figures in hand a teacher can profitably study her class and determine somewhat more completely than it is possible to do for the whole school system what are the special explanations of each individual type of ability."

TABLE 9

RELATION BETWEEN QUALITY OF READING AND RATE

(From Cleveland Survey)

		Quality		
		Good	Medium	Poor
Speed	Rapid	10%	11%	4%
	Medium	12%	26%	12%
	Poor	4%	12%	9%

Note: Interpet this table as follows: 10% of the pupils tested were good in quality and rapid in speed; 11% were medium in quality and rapid in speed; 4% were poor in quality and rapid in speed; etc.

In a study by Whipple and Curtis (41) on the effect of skimming in reading, in which they used six subjects, university students and instructors, and tested them in effectiveness of different ways of reading, they say that the slowest reader is the poorest reproducer, and that the best reproducer is a fast, though not the fastest reader.

Quantz (31) found that the rapid readers were on the average about 37 percent better than the slow in quality of work. He says, "It might be supposed that greater rapidity was gained at the sacrifice of exactness or of intelligence. This supposition is negatived by an examination of the amount of and quantity of the material reproduced. A comparison between the ten most rapid readers and the ten slowest readers shows that the rapid readers remember more of the original thoughts, and that the

character of their reproduction is much higher, both generally and with reference to expression and to logical content."

C. T. Gray (11) concluded, after giving three press selections,—one easy, one medium, and one difficult,—to two subjects to read as rapidly as possible and then to reproduce content, that his subjects were able to increase their rate of reading without reducing their efficiency.

Germane (10) attacked the problem of the relation of rate to comprehension by giving a reading test to grades VI, VII, and VIII over two types of material. The rate was carefully checked and the comprehension ability was determined by the number of correct answers that were given to questions covering the materials read. She found the correlation existing between rate and comprehension to be as follows.

TABLE 10

CORRELATION BETWEEN SPEED AND COMPREHENSION IN SILENT READING AS MEASURED BY IMMEDIATE RECALL

(From Germane)

Material	Correlation		
	Grade VI	Grade VII	Grade VIII
Peanuts	.36	.42	.20
Tuberculosis	.41	.27	.37

She concludes: "There is a positive correlation between speed and comprehension in silent reading. There are many exceptions; that is, some rapid readers are poor in comprehension while some of the slow readers are good in comprehension. The majority of students who comprehend well are rapid readers and the majority who do not comprehend well are slow readers."

Germane did not include any measure of variability in her table. It would be interesting to know the probable error or the standard deviation in this connection.

Abell (1) was also interested in this problem. She took forty-one college girls for her experiment. They were asked to read a specific story at home and time their reading. At the following class meeting they were asked to reproduce as much of the story as they could remember. Their reproductions were examined with reference to the percentage of words identical with the original, the percentage of thoughts omitted, and the percentage of thoughts imperfectly remembered. She reached two conclusions that are pertinent to this part of the study. First, the majority

of these subjects gain by relative slowness, that is, by a rate slower than their ordinary one, although the speediest readers headed the list in comprehension. Second, comprehension may be independent of absolute rate of reading since in the three classes of readers,—fast, slow, and moderate,—some comprehended well and others fairly well or poorly.

King (22) made some interesting investigations along this line. He made a comparison of slow and rapid readers. He used 94 university students in the spring of 1916. The group was tested twice for reading rate and reading quality. These students were distributed through three university classes. They were divided into fast and slow groups by telling each alternate student to read slowly and carefully, and the others to read rapidly but also carefully. They read an article for ten minutes. The slow group was told not to read beyond a certain point. Then questions were asked over the material read, fourteen for slow and four additional ones for fast readers. The fast readers got 370 out of a possible 832 points, or 44.5 percent. The slow group got 345 out of a possible 645 points, or 53.3 percent. When measured by the 14 points for each group instead of 14 for the slow and 18 for the fast the results were as follows: fasts, 295 rights out of a possible 645 or 45.7 percent as over against 345 or 53.3 percent for the slows.

A second test was given in which the group was divided on the basis of normal rate of reading. In this case, the fast 25 percent made an accuracy score of 50.2 percent, the slow 25 percent made an accuracy score of 48.0 percent, and the middle 50 percent, 46.5 percent.

In a comparison of rate of reading with quality, 93 students gave r equals —.07. When those subjects were selected who read at their natural rates in both tests we have:

	First test	Second test
The 26 naturally "slow" readers:	51.2%	55.5%
The 27 naturally "fast" readers:	48.5%	42.9%

The third experiment (23) conducted some time later with a different group of people showed a correlation between speed and quality of r equals —.27. The average percentage of quality for successive quartiles from fastest to slowest were 60 percent, 34 percent, 64 percent, and 67 percent respectively.

A fourth experiment gave results as follows:

Of the 19 rapid readers 5 equalled or excelled the median
Of the 19 rapid readers 2 equalled or excelled the 75 percentile
Of the 19 slow readers 14 equalled or excelled the median
Of the 19 slow readers 9 equalled or excelled the 75 percentile
Average accuracy for the "fast" quartile was 41.8%
Average accuracy for the "slow" quartile was 53.0%

The correlation between rate and comprehension was r equals —.47.

With all the above evidence on the effect of rate on comprehension, it seems that we do not have sufficient data to draw definite conclusions. Slow readers are sometimes among the best in comprehension and again among the poorest, and the same holds true for the fast readers. The need exists for further experimentation in this direction. Perhaps each person has an optimum rate at which he can get the most out of his reading. If so, we should seek to discover that rate and adjust our reading requirements to it.

4. *Articulation and Lip Movements*

In the development of efficient comprehension in silent reading all depressing or distracting elements should be eliminated or at least reduced to a minimum. There has been considerable experimentation concerning the effects of articulation, vocalization, inner speech, and lip movements, which are habits ordinarily developed in connection with oral reading. The summary below gives a digest covering part of this work.

Quantz (31) concludes that lip movement is a serious hindrance to speed of reading and consequently to intelligence of reading. His experiments showed a definite increase in ability to reproduce as there was a decrease in amount of lip movements.

Germane (10) found that the average of lip readers in comprehension falls below the median for an entire group. She conducted experiments involving 288 individual pupils, 73 of whom were consistent lip readers. In four cases out of six from 54 percent to 67 percent of the lip readers were below the median for the whole grade. In the other two cases, 43 percent and 44 percent respectively were below the median for the whole grade.

Pintner (28) after reviewing the work that had been done in connection with inner speech and articulation by previous writers, conducted experiments to determine whether articulation could be eliminated and if so, whether by practice the ordinary rate of

reading and average degree of comprehension could be attained. His method was that of having his subjects repeat over and over the numbers 13, 14, 15, 16, 13, 14, 15, 16, etc., while they were reading short passages from *Munsey's* and *The American* magazines. Each passage had ten definite ideas upon which the individuals were tested for comprehension. He concluded that articulation during the reading process is a habit which is not necessary for that process. The evidence presented in his review of the experimental and psychological studies in this field indicated that articulation is to be looked upon as a hindrance to comprehension as well as to speed.

C. T. Gray (11) took two subjects who had the habit of vocalization in a marked degree and gave them training to reduce it. The training continued for twenty days. The length of time for each day was from twenty to thirty minutes. He summarized his results as follows: "Training in reading without vocalization results in a marked decrease in this motor accompaniment of reading. In five of the seven tests taken by the two subjects there is a loss in comprehension. In one of the tests, no change is shown in the results of comprehension, and in one test there is a gain. These results indicate that vocalization in the case of these children was a help in comprehension and that when it was removed there was a decrease in comprehension." However, had this period of training been lengthened to the point where one might be assured that the habit of not articulating had been thoroughly formed, the decrease in comprehension might have disappeared. This and other experiments of its kind show the difficulty of eradicating bad reading habits which should never have been allowed to be formed.

Closely related to the problem of lip movement and articulation is that of oral reading itself. Mead (25) tested 112 sixth grade pupils of Cincinnati, and found that each class (five in all) reproduced a greater percentage of possible points by the silent method. Seventy-one percent of the pupils taken individually did better by this method. Later these same tests were used with 340 pupils from the third to the tenth grade, the ninth not included. Fifteen out of seventeen classes did better by the silent method. Seventy per cent of the children taken individually did better by this method.

Pintner (29) tested 23 children in the fourth grade to find out the most efficient method of reading; oral or silent. He gave eight tests for oral and eight for silent reading. Each test consisted of reading as must as possible during a period of two minutes. The following table gives his results.

TABLE 11

AVERAGE NUMBER OF LINES READ AND POINTS REPRODUCED

(From Pintner)

	Oral Lines	Points	Silent Lines	Points
Class total	461	343	652	405
Averages	20	15	28	18
Percentages	34M.V.	.06	40M.V.	.07

The foregoing experiments, while not conclusive, seem to indicate that efficiency in comprehension is decreased by such habits as lip movement, articulation, and oral reading. The one example of contrary evidence presented might have turned out differently if the period of training had been lengthened.

5. *Poor Environment*

The effect of the influence of environment on comprehension is hard to determine. Such suggestions as we have are frequently the result of observation rather than the outcome of specific and scientific studies. One way of securing more scientific data on the effect of environment on comprehension would be to conduct careful experiments on individuals alike in intelligence, vocabulary, and such other factors as we can control, but coming from different environments. This, so far as the writer has been able to find, has not been done. Gray (12), after investigating the schools of Indianapolis, remarks concerning economic conditions in relation to achievement in reading: "The relation of economic conditions to achievement in reading is brought in in a very interesting way in table IV, ... Schools C. G. H. and M. were classed as "Very Good" schools in regard to economic conditions by school officers of Indianapolis. Schools G.H. and M. rank very high in oral-reading ability. There must be some other factor affecting C. Schools A. E. F. and L. were ranked "Fair" as to economic conditions. They rank lower in reading ability than G. H. and M. schools. B. and K. rank low in both economic conditions and reading. Gray attributes the cause of difference to lack of books in the homes of the latter."

The question of race is one that must be considered in the

general topic of environment. Do children of foreign parents or those coming from districts which are largely foreign rank lower or higher than American children?

The Cleveland Survey (20) showed the oral reading of the Jewish children to be distinctly above the average and that of Italian children much below.

TABLE 12

ORAL READING SCORES IN THE GRAY TEST BY PREDOMINATING NATIONALITY

(After Judd)

Grade	Cleveland Average	American	Italian	Polish and Bohemian	Jewish
I	31	37	21	21	32
II	42	44	25	40	48
III	46	47	28	44	50

Gray (13) reports that foreign speaking children made lower scores in quality of silent reading than did English speaking children according to the St. Louis Survey. Jewish children formed an exception to this rule.

In a general way, it seems that the economic and home conditions of pupils influence the scores that they are able to make on comprehension tests.

6. *Too Little Reading Practice*

(Neglect of Law of Exercise)

What is the effect of reading practice, either by means of extensive reading of books, etc., or by means of speed drills, on ability to comprehend material read? We have few data collected thus far in answer to this question. Hunt (19) undertook to get some light on this question by dividing his pupils into two groups and testing the comprehension ability of each. In one group he placed all those who had read more than one book a week, and called them extensive readers, (Group A below). Those who read less than the above he called the non-readers, (Group B below). By using Gray's Oral and Monroe's Silent Reading tests, he obtained the following scores for each group. He used one fourth and three seventh grades for the experiment.

TABLE 13
EFFECT OF EXTENSIVE READING ON COMPREHENSION
(From Hunt)

Grade IV	Gray Oral Score	Monroe Rate	Monroe Comp.
Group A	47	76	9.5
Group B	39.4	54	5.4
Grade V	**Otis Scale**	**Monroe Rate**	**Comp.**
Group A	91 Med.	135	23.5
Group B	90 Med.	107	17.1

Correlations (Pearson): Intelligence with Rate =.38
Intelligence with Comp.=.48

Gray (13) in commenting on the results of the St. Louis Survey, says, "The superior results secured by St. Louis are due in part to two methods which are followed by a majority of the teachers. In the first place, it has already been mentioned that St. Louis devotes a great deal of time to quantitative oral reading in these grades with attention directed to the content side. This method increases the rate of reading, brings the pupil in contact with a much wider range of reading material, and improves in a very noticeable way his power over the meanings of words. In the second place, a large proportion of the pupils in St. Louis read a large number of books silently during the second and third grades. It has already been mentioned that the pupils of some classes read as much as one book each week. As contrasted with the pupils who do not have this opportunity, these extensive readers should show marked superiority both in rate and quality of silent reading. The objective tests verify these assumptions."

Woody (42) quoted by Theisen, asked teachers in grades III, IV, and V to estimate the number of pages their classes read during a current semester. He then correlated this figure with comprehension and with rate on the Monroe test. He found rather marked correlation (Spearman method) in the third grade, but in the other grades it was low. Theisen (37) found the correlation (Pearson method) between the score on Haggerty reading test and books read by each individual during the year, as reported by teachers for grades I and II to be as follows.

TABLE 14
CORRELATIONS BETWEEN AMOUNT READ AND SCORES IN READING TESTS
(Theisen)

Grade	No. Pupils	Amount and Score on Test I	Amount and Score on Test II
I	210	.47	.44
II	190	.14	.09

Here again the correlations were significant in one grade and not in the other.

Hilliard (15) collected data from seventeen fifth grade pupils of the University of Iowa Elementary School in which the teacher had asked each pupil to note carefully the number of pages read outside of their regular school work for a period of eight weeks. When the total number of pages thus read was correlated with the scores earned on the Thorndike-McCall reading test he found r to be $.159 \pm .159$.

Zirbes (43) in a study on Diagnostic Measurement as a basis for improvement gives as one of the factors for efficiency and economy of instruction the provision for suitably graded extensive reading. The class upon which she experimented consisted of 20 boys.

Peters (27), after conducting an experiment to determine the influence of speed drills upon rate and comprehension, says that his investigation showed 16.7 percent increase in speed without injuriously affecting quality, and suggests the advisability of giving speed drills as a part of teaching reading.

Uhl (40) carried on investigations to determine if ability to comprehend what was read could be improved. His pupils were tested by means of Kelley's silent reading test and were then given a series of practice exercises which were calculated to improve their ability in comprehension. These exercises lasted four weeks. Then the pupils were tested again. In every grade from IV to VIII rather significant gains were made. His scores show that ability to comprehend the meaning of what is read improves throughout the grades, and that quality of silent reading may be improved through training.

TABLE 15

INFLUENCE OF ONE MONTH'S DRILL ON COMPREHENSION

(From Uhl)

Grade	Standard Score	Score First test	Score Second test
IV	9.9	4.2	7.7
V	13.7	10.3	14.6
VI	13.4	8.9	15.4
VII	16.5	12.8	15.8
VIII	18.8	17.8	25.1

7. *Poor School Attendance*

We have little information concerning the influence of school

attendance on ability to comprehend. Theisen (37) found the correlation between attendance and attainment in primary reading on the Haggerty Achievement Reading Tests to be negligible for children who had had kindergarten training and who had attended school 130 days or more at the time of the test in May. The Pearson correlation between attendance and score for first grade children selected at random was .617 for test I, and —.003 for test II. For 190 second grade children, similarly selected, the corresponding figure in the case of test I was .073. Theisen states that absences that aggregate less than two months in the course of a year have little effect on primary reading, as compared with such other factors as intelligence, quality of teaching, and amount of reading done. He adds later, "Long periods of interruption would probably interfere materially with progress," and refers to Packer and Anderson's study on the effect of the summer vacation on rate as evidence to support this conclusion.

Packer and Anderson (26) found that the children of 1B grade who read 50 words per minute in May, read but 44 in September. Corresponding figures were: for 1A, 84 and 49; for 2B, 125 and 68; and for 2A, 145 and 125 respectively.

8. *Small Recognition Span*

Rhynsberger (32) measured the effect of drill on word groups as a factor in increasing the rate and improving the comprehension of silent reading. Her work was done in the second grade with fifteen pupils. She drilled the pupils on groups of words, selected from a story used in the test. Seven minutes daily for six days were taken for the drill. Her final conclusions are: "Deducting the amount of gain due to rereading a selection, there still remains a gain of 60 per cent in the Index of Comprehension, 15 percent in the number of words read per minute, 24 percent in the number of questions answered in five minutes. This seems to be due to a total of forty-two minutes' drill on word groups."

Gray (12) in his study of reading in the elementary schools of Indianapolis, recommends drill on easy material to develop wide units of recognition. His idea of the importance of this factor is shown in the following quotation: "As was pointed out earlier in the discussion, progress in silent reading ability involves an enlargement of the units of recognition. Scientific studies have shown that the reader of average ability uses only a part of the

possibilities of recognition which are supplied by his field of clear vision. An enlargement of the units of recognition demands broad experiences which make possible the comprehension of meaningful phrases in a single fixation of the eyes, freedom from the difficulties which new and unfamiliar words present, and freedom from the limitations of vocalization."

9. *Lack of Motivation*

Hoover (17) attempted to discover the influence of motivated drill work in third grade silent reading. He constructed four sets of cards containing "action sentences" which would lend themselves readily to dramatization in the school room. The experiment was carried out with 1,139 children in thirty different third grade rooms. These were tested by Monroe's Silent Reading Test, both at the beginning and at the end of the study. The 1,139 pupils were divided into two groups of equal size and mental attainments by using the superintendent's judgment. The study lasted from January 1 to April 1, 1920. The drill group received drill on the cards 10 minutes a day on Mondays, Wednesdays, and Fridays. He found that the drill section increased its median comprehension score from 4.0 to 9.0 while their average deviation increased from 3.1 to 4.5. At the same time the non-drill section increased its median comprehension score from 3.9 to 7.0, while its average deviation increased only from 3.3 to 3.7. From his study he drew the following conclusions: "Greater use must be made of the doctrine of 'Interest in Education,' especially as it applies to drill work. Drill work should be motivated or vitalized by being connected with some dynamic purpose. Bodily activity (dramatization, handling of objects, etc.,) can be profitably connected with exercises in silent reading."

Shepherd (33) after several years' experience in the Junior High School connected with the University of Chicago, divides her poor readers into five groups, one of which is, "lazy, hazy, purposeless readers." This represents a type that proper motivation would possibly help.

10. *Lack of Organization Ability*

Horn (18) in his article on "A Constructive Program in Silent Reading," mentions the ability to organize as one of five main abilities underlying effective silent reading. By ability to or-

ganize is meant the ability to get at the main points and to arrange them logically, usually according to some purpose.

The lack of this ability is mentioned by Thorndike (38) as one of the underlying causes of errors in reading. After examining the answers to questions over sentences and paragraphs, he concludes as follows: "Understanding a spoken or written paragraph is then a matter of habits, connections, mental bonds, but these have to be selected from so many others, and given relative weights so delicately, and used together in so elaborate an organization that 'to read' means 'to think,' as truly as does 'to evaluate' or 'to invent' or 'to demonstrate' or 'to verify.'"

In another article, (39) he writes, "It appears that reading an argumentative or explanatory paragraph and, in a less degree, narrative and descriptive, involves the same sort of organization and analytic action of ideas as occurs in thinking of supposedly higher sorts."

Briggs (4) mentions the organization of facts as one of four principles which underlie silent reading. He says, "We ought to train children to have the habits of organizing the facts worth retaining. I have the habit of jotting down the questions that the article I am reading ought to answer. If I have read this article well, I ought to be able to answer them; if not, I ought to go back and read the article again. Often just turning the pages tends to fix matter in the mind. A summary is a good thing, and an organized topical outline is a good thing, for the organization of facts." Here again is an opportunity to follow up what appears to be a sound psychological principle by scientific experimentation.

11. *Inability to Reproduce*

The ability to reproduce has been given as a measure of effective reading. Anderson and Merton (2) give inability to reproduce as one of four defects occurring in silent reading affecting comprehension, and suggest definite training exercises for developing it.

Kallom (21) states that reproduction is a measure of reading ability. He says that the factors which underlie silent reading are: (1) correct visualization of each word, (2) knowledge of the various meanings of each word, (3) the choice of the correct meaning as shown by the context, (4) forming the correct relations between these meanings in order to interpret phrases and clauses,

(5) forming the correct relations between phrases and clauses in order to interpret sentences and paragraphs. He then says that this interpretation of words, phrases, sentences, and paragraphs depends on at least two things: (1) the pupil's experience, and (2) his ability to recall the experience and apply it to the case at hand. Wrong interpretation, he believes, can be discovered only through some form of reproduction. He tested pupils in grades IV to VIII in order to obtain the data from which these conclusions are drawn.

12. *Lack of Ability in Reasoning*

Thorndike (39) gives as principles of correct reading the following:

"(1) Each word produces a correct meaning;
(2) Each such element of meaning is given a correct weight in comparison with the others;
(3) The resulting ideas are examined and validated to make sure that they satisfy the mental set or adjustment or purpose for whose sake the reading was done."

These conclusions or principles were formulated after analyzing a large number of responses to questions over various paragraphs used as tests.

The relation between reasoning and comprehension may be seen from another angle by comparing scores earned in comprehension tests with those earned in so-called reasoning tests such as those in arithmetic. Cline (6) made such a study by using 346 unselected pupils in grades VI to IX inclusive in two Iowa school systems. Using Monroe's Comprehension Test and Stone's Reasoning Test, he found the correlations between the two to be .65. This correlation, however, was reduced to .32 when intelligence, as measured by the Pressey Mental Survey, Schedule D, was partialled out. From his study we may conclude that there is a significant relationship existing between comprehension as measured by Monroe's test and reasoning as measured by Stone's test.

SUMMARY

The foregoing discussion reveals, it is true, some differences in opinion. We are able, however, to draw the following conclusions which are supported by the writers quoted:

(1) Comprehension is not a simple ability; it is affected by a

great many other abilities and conditions, concerning twelve of which we have been able to find more or less experimentation. These twelve are: intelligence, vocabulary, rate, lip movements, environment, amount of reading practice, school attendance, recognition span, motivation, organization, reproduction, and reasoning.

(2) A classroom teacher by knowledge of these factors and their relative importance can materially aid the progress of her pupils.

This chapter makes no attempt to do more than merely name some of the factors in reading comprehension already in the minds of educators. In time we shall probably have more extensive data on all these, and any other factors which may enter in, so that we shall know the relative importance of each and the possibility of their successful development in the school room. At present, even for some of these twelve there are no adequate tests available. The writer has chosen, in the next chapter, six of the above mentioned abilities and conditions for which he felt there was adequate standardized material for experimentation. His contribution will be to determine, as nearly as possible, through statistical procedure, the effect of each of these six factors upon comprehension.

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CHAPTER III

THE RELATION OF SIX SELECTED ABILITIES TO COMPREHENSION IN SILENT READING

In order to deal intelligently with the difficulties mentioned in the preceding chapter, we must endeavor to determine the relative importance of each, and the part of the whole reading disability that this particular list constitutes. Unfortunately, for some of these difficulties we lack specific measurements; but for others tests are available or may be readily improvised. After considering such tests as were available, the following abilities and conditions were selected, in which difficulty or lack may indicate deficiency in comprehension: (1) general intelligence, (2) vocabulary, (3) rate of reading, (4) ability to reproduce, (5) lip movements, (6) organization. Tests covering these abilities and conditions were given to groups of fifth grade children, and the results of these tests were treated statistically.

For convenience, the chapter is divided into two sections. Section A represents the results of the tests given to a group of twenty-five children in the fifth grade of the University Elementary School. In section B the tables are made from the results of tests given to four groups of fifth grade children from the Polk, Jackson, Buchanan, and Johnson Schools of Cedar Rapids, Iowa. There were one hundred and thirty-six children in these four groups.

SECTION A

The purpose of this section is to show the relationship between scores made by the fifth grade pupils in the University of Iowa Elementary School in tests covering each of the above mentioned abilities and conditions and their scores in comprehension tests. The abilities and conditions will be taken up in turn as mentioned above. This relationship was determined by correlations computed according to the method given by Rugg in his *Statistical Methods Applied to Education*, 233-276. As will be seen in the accompanying tables, four different tests in comprehension were used, and each of them was correlated separately with each test in the other

abilities. The writer made no attempt to formulate a general score for comprehension or any of the other abilities. No correlation will be found for lip movements. In this case tables will be found giving direct comparisons between comprehension scores and the amount of lip movement observed. For a list of the tests used, the reader is referred to Chapter I, page 12. Table 16 shows the comparison of the original scores for each individual in each of the four comprehension tests. Table 17 shows the correlations existing between them.

TABLE 16

COMPARISON BETWEEN COMPREHENSION SCORES (FOUR TESTS) FOR EACH PUPIL IN EACH TEST

Pupil No.	Monroe Comp Score	Thorndike-McCall Score	Burgess Score	Courtis* Score
1. A	49	55	82	47
2. B	35	51	64	57
3. C	35	57	58	39
4. D	32	36	22	14
5. E	29	53	52	54
6. F	29	53	82	49
7. G	28	49	46	36
8. H	28	65	46	40
9. I	23	59	58	48
10. J	23	53	22	43
11. K	19	47	52	46
12. L	19	53	52	53
13. M	13	45	28	24
14. N	13	51	40	49
15. O	13	44	34	34
16. P	12	49	46	48
17. Q	12	49	40	36
18. R	10	51	10	28
19. S	10	51	34	33
20. T	8	51	46	42
21. U	7	49	28	27
22. V	7	45	34	44
23. W	5	43	34	31
24. X	5	43	22	14
25. Y	0	34	10	24
Mid Measure	13	51	40	40
Med. Variations		4	12	8

* Score on Courtis is number of questions correct.

TABLE 17

CORRELATIONS BETWEEN THE VARIOUS COMPREHENSION TESTS USED

	Monroe	*Th.Mc.*	*Courtis*	*Burgess*
Monroe		.442±.109	.447±.108	.716±.066
Th. Mc.	.442±.109		.690±.071	.534±.095
Courtis	.447±.108	.690±.071		.622±.082
Burgess	.716±.066	.534±.095	.622±.082	

There seems to be quite general agreement among the four tests used to measure comprehension. The most exceptional case is perhaps that of Pupil "D," whose score was among the highest on the Monroe Test and among the lowest on each of the others. Personal observation of his case and the judgment of his teachers agree that he is rather erratic,—most of the time apparently dull, but occasionally showing flashes of brilliancy. The correlations would be classed as "marked" or "high" by authorities in the field of educational statistics.*

1. *General Intelligence*

Three tests (see Chapter I) were used in checking this factor, and Table 18 shows correlations and probable errors between each of them and the four measures of comprehension.

TABLE 18

CORRELATION BETWEEN THE THREE INTELLIGENCE TEST SCORES AND EACH OF THE COMPREHENSION TEST SCORES, GRADE V, UNIVERSITY ELEMENTARY SCHOOL, UNIVERSITY OF IOWA

	Intelligence					
	Stanford (I.Q.)		Terman		Otis	
	r	P.E.	r	P.E.	r	P.E.
Monroe Comp.	.380	.117	.609	.085	.459	.096
Thorndike-McCall	.541	.097	.827	.041	.698	.087
Burgess	.466	.107	.906	.024	.452	.117
Courtis	.636	.081	.709	.064	.785	.053

This table furnishes additional evidence that educators are correct in assuming that comprehension in reading is affected by general intelligence. With correlations ranging from .38 to .90, most of them above .60, one can hardly under-emphasize the importance of this factor. Since intelligence is not considered subject to training, with tests which measured these abilities absolutely accurately one could assume that a child was reaching a satisfactory level in reading when his rank in his group in comprehension corresponded exactly to his rank in intelligence. Practically we cannot now make such a hard and fast rule, but we may at least assume that a child whose comprehension score falls considerably below his intelligence score can be improved by training.

2. *Vocabulary Limitations*

A limited vocabulary is frequently given as a cause of disability in comprehension. Increased word knowledge according to various writers is one of the most important means of making progress

* See Rugg, H. O. *Statistical Methods Applied to Education*, p. 256. Also *Twenty-First Year Book, National Society for the Study of Education*, Part I, p. 68.

in silent reading. This part of the study attempts to discover what relationship exists between low scores on the comprehension tests used above and word knowledge. Several tests were available for measuring word knowledge or ability in vocabulary. (See Chapter I.)

TABLE 19

CORRELATIONS BETWEEN THE VOCABULARY TEST SCORES AND SCORES ON EACH OF THE COMPREHENSION TESTS, GRADE V, UNIVERSITY ELEMENTARY SCHOOL, UNIVERSITY OF IOWA

	Vocabulary							
Comprehension	Thorndike Vis. Vocab.		Vasey Vocab.		Monroe Vocab.		Dutch Homestead Vocab.	
	r	P.E.	r	P.E.	r	P.E.	r	P.E.
Monroe	.425	.097	.303	.123	.439	.109	.629	.081
Thorndike-McCall	.689	.071	.438	.109	.824	.042	.737	.052
Burgess	.599	.086	.575	.090	.561	.092	.775	.054
Courtis	.536	.096	.407	.114	.561	.092	.779	.049

The correlations between comprehension and vocabulary are slightly lower than those given previously on comprehension with intelligence (cf. Tables 18 and 19). Still they are relatively high (.30 to .82 with all but one above .40) and show that a knowledge of words is decidedly a factor in comprehension. Training in vocabulary, with proper motivation, is a type of work well within the grasp of every teacher, and from this evidence seems to be one of the strategic points in building up comprehension. In those cases previously alluded to, when comprehension falls far below intelligence, this type of training would probably do much toward lessening the difference.

3. *Organization*

The ability of the pupils to organize was measured by Greene's Organization Test. The author of this test makes no claim that it is a measure of the organizing ability required in silent reading. However, it is one of the few standardized tests in organization, and as such was chosen for this study. Table 20 shows the correlations between it and the four comprehension tests.

TABLE 20

CORRELATIONS BETWEEN ORGANIZATION (GREENE ORGANIZATION TEST) AND THE FOUR COMPREHENSION TESTS

	Organization	
	r	P.E.
Monroe	.250	.126
Thorndike-McCall	.613	.084
Burgess	.549	.094
Courtis	.566	.092

Three of the four correlations lie between .54 and .63, which are six or seven times the probable error. In the other correlation the probable error is so large that the correlation is of little value. However, with three high correlations against one low one, which is affected to a considerable extent by the erratic case of pupil "D," we may conclude that as far as the zero order correlations may be relied upon, organization is a vital factor in comprehension.

4. *Rate of Reading*

Table 21 shows the correlations between rate as measured by three tests and the four comprehension tests. The "Dutch Homestead" test* consisted of a short paragraph which the children were told to read at their usual rate.

TABLE 21

SHOWING THE CORRELATIONS BETWEEN RATE OF READING AND SCORES ON COMPREHENSION TESTS. GRADE V, UNIVERSITY ELEMENTARY SCHOOL, 1921-1922

	Monroe		Dutch Homestead		Courtis	
	r	P.E.	r	PE.	r	P.E.
Monroe	.718	.075	.481	.104	.711	.067
Thorndike-McCall	.164	.131	.135	.132	.485	.103
Burgess	.459	.107	.508	.099	.726	.067
Courtis	.123	.132	.343	.119	.658	.076

The findings in the table of correlations just given bear out in a very striking manner the opinions of educators as quoted in Chapter II. The opinions varied greatly and the correlations show the same tendency, ranging from .12 to .72. Note that in general the highest correlations exist where rate and comprehension are measured by the same test, and that where the two are measured independently the correlation drops materially. Only two exceptions to this are found. The author reiterates his opinion as stated in the summary of the section on rate in Chapter II that until we have a great deal more experimentation on the subject, we should strive to discover the most rapid rate at which each child can read with the best results in comprehension, and not push him to a rate where comprehension is affected in a detrimental way.

5. *Reproduction*

Ability to reproduce was measured by Whipple's "Dutch Homestead" test. Each child was told to read the selection through

* For the paragraph used in this test see Whipple, *Manual of Mental and Physical Tests, Complex Processes*, p. 210.

once at his usual rate. When he had finished he was told to lay the test face downward and begin immediately to write out as much of the story as he could remember. The number of ideas each pupil was thus able to reproduce formed his score.

TABLE 22

CORRELATIONS BETWEEN SCORES IN REPRODUCTION (DUTCH HOMESTEAD TEST) AND THE FOUR COMPREHENSION TESTS

	Reproduction	
	r	P.E.
Monroe	.343	.119
Thorndike-McCall	.277	.114
Burgess	.615	.083
Courtis	.643	.079

One test in reproduction is probably not sufficient to establish definite conclusions. Since, however, the correlations with this one test show rather wide variations, when the different comprehension tests are considered, it seems fair to assume that more tests would only accentuate such variations. The correlations with two of the tests of comprehension were rather low and on the whole this is as one would expect, since reproduction can readily be seen to be dependent upon other abilities such as writing, language, memory, etc. With the other two correlations so much higher, the writer hesitates to express a definite opinion concerning the relationship between these factors without further experimentation. It is certainly not so important as either intelligence or vocabulary.

6. *Lip Movements*

To detect lip movers among the group, the class-room teacher watched the children carefully during all the silent reading periods of an entire day. Each child was placed in one of three classes according to whether he used his lips none, little, or much in his silent reading. In addition to this, the writer checked the children in a similar manner as he conducted certain silent reading tests with them. Table 23 is based on the results of the two checkings. By "none" is meant that absolutely no movements of the lips or articulatory organs were visible. By "little" is meant that the pupil used his lips at times or to a limited degree. By "much" is meant that the lips were moved constantly.

TABLE 23

COMPARISON BETWEEN COMPREHENSION SCORES AND LIP MOVEMENT, GRADE V, UNIVERSITY ELEMENTARY SCHOOL, 1921-1922

Pupil No.	Monroe Comp.	Thorndike McCall	Burgess	Courtis	Lip Movement
1. A	49	55	82	47	None
2. B	35	51	64	57	None
3. C	35	57	58	39	None
4. D	32	36	22	14	Some
5. E	29	53	52	54	None
6. F	29	53	82	49	None
7. G	28	49	46	36	None
8. H	28	65	46	40	None
9. I	23	59	58	48	None
10. J	23	53	22	43	Some
11. K	19	47	52	46	None
12. L	19	53	52	53	None
13. M	13	45	28	24	Some
14. N	13	51	40	49	None
15. O	13	44	34	34	None
16. P	12	49	46	48	None
17. Q	12	49	40	36	Some
18. R	10	51	10	28	Some
19. S	10	51	34	33	None
20. T	8	51	46	42	None
21. U	7	49	28	27	Much
22. V	7	45	34	44	Some
23. W	5	43	34	31	Much
24. X	5	43	22	14	Much
25. Y	0	34	10	24	Some
Median	13	51	40	40	

Number in lower half comp. not using lips	5
Number in upper half comp. not using lips	10
Number in lower quarter comp. using lips (some or much)	5
Number in upper quarter comp. using lips (some or much)	0
Number in lower quarter comp. using lips much	3

The conclusions to be drawn from Table 23 agree with those of Germane and other writers quoted in Chapter II, that lip movers are seldom those who comprehend well. The exact amount that lip movement affects comprehension directly is rather hard to determine, since most children who are habitual lip movers rank low in intelligence. Probably the effect of lip movements is more harmful to speed in reading than to comprehension. As has been pointed out, however, in some of these tests comprehension and rate are interdependent in determining the final score, hence lip movement would influence comprehension scores indirectly.

The foregoing tables disclose a significant relationship between the measures of comprehension and the various other tests. For

convenience all the correlations given previously are brought together in a summary table, which appears as Table 24 following.

TABLE 24

CORRELATIONS AND PROBABLE ERRORS BETWEEN THE FOUR COMPREHENSION TESTS AND THE TESTS OF INTELLIGENCE, VOCABULARY, RATE, REPRODUCTION AND ORGANIZATION, UNIVERSITY ELEMENTARY SCHOOL, GRADE V

	Comprehension Tests							
	Monroe		Th-McCall		Burgess		Courtis	
No. Cases	r	P.E	r	P.E.	r	P.E.	r	P.E.
INTELL.								
24 Stanford (Ind.)	.380	.117	.541	.097	.466	.107	.636	.081
25 Terman (Grp.)	.609	.085	.827	.041	.906	.024	.709	.067
21 Otis (Grp.)	.459	.096	.698	.087	.452	.117	.785	.053
VOCAB.								
25 Th. Vis.	.425	.097	.689	.071	.599	.086	.536	.096
25 Vasey	.303	.123	.438	.109	.575	.090	.407	.114
25 Monroe	.437	.109	.824	.042	.561	.092	.561	.092
25 Dutch H.	.629	.081	.737	.052	.775	.054	.799	.049
ORGAN.								
25 Greene	.250	.126	.613	.084	.549	.094	.566	.092
RATE								
25 Monroe	.718	.075	.164	.131	.459	.107	.123	.132
25 Dutch H.	.481	.104	.135	.132	.508	.099	.343	.119
25 Courtis	.711	.067	.485	.103	.726	.067	.658	.076
REPRO.								
25 Dutch H.	.343	.119	.277	.114	.615	.083	.643	.079

Note that the above correlations for the most part are based upon twenty-five cases. This number is so small that unless correlation is five or six times the probable error, it has little significance. Keeping this in mind, one can see that part of these correlations are valueless. Notably is this true for rate and reproduction. If we consider the correlations real when they are five or more times as great as their respective probable errors, we find that nine out of twelve of the correlations based on intelligence are such; in the same way, eleven out of sixteen of those based on vocabulary, three out of four of those based on organization, five out of twelve of those based on rate, and two out of four of those based on reproduction, may be said to be real. Using the proportion between the correlations that are real as defined above and the total number of correlations made, and also the respective size of the correlations as a criterion, the five abilities should be ranked in the order given above in significance. Therefore, of the five abilities compared, the first three are more important in predicting efficiency in comprehension than are rate and reproduction.

Inter-correlations were computed between one test in each of these five abilities and one of the comprehension tests, but on ex-

amination of the data obtained in this manner, it was decided to use only intelligence, vocabulary, and organization in the remaining portions of this study. Also it seemed unnecessary to use all of the tests mentioned in Table 24, for these inter-correlations Those selected were: (1) *comprehension*: Monroe, Thorndike-McCall, Burgess, and Courtis; (2) *intelligence*: Terman Group; (3) *vocabulary*: Thorndike Visual; (4) *organization*: Greene.* These particular tests were selected, first because they had been given to all of the pupils in the fifth grade of the Elementary School, and second because of the ease of administration in giving them in other school systems.

TABLE 25

INTER-CORRELATIONS BETWEEN COMPREHENSION (MONROE), INTELLIGENCE VOCABULARY, AND ORGANIZATION ABILITIES

	Monroe Comp.		Terman Gr.		Vis. Vocab.	
	r	P.E.	r	P.E.	r	P.E.
Terman Group	.609	.085				
Th. Vis. Vocab.	.425	.095	.547	.095		
Organization	.250	.126	.754	.058	.387	.112

TABLE 26

INTER-CORRELATIONS BETWEEN COMPREHENSION (THORNDIKE-McCALL), INTELLIGENCE, VOCABULARY, AND ORGANIZATION ABILITIES

	Thorndike-McCall		Terman		Vis. Vocab.	
	r	P.E.	r	P.E.	r	P.E.
Terman Group	.827	.041				
Th. Vis. Group	.689	.071	.547	.095		
Organization	.613	.084	.754	.058	.387	.112

TABLE 27

INTER-CORRELATIONS BETWEEN COMPREHENSION (BURGESS), INTELLIGENCE, VOCABULARY, AND ORGANIZATION ABILITIES

	Burgess		Terman		Vis. Vocab.	
	r	P.E.	r	P.E.	r	P.E.
Terman Gr.	.906	.024				
Th. Vis. Vocab.	.599	.086	.547	.095		
Organization	.549	.094	.754	.058	.387	.112

TABLE 28

INTER-CORRELATIONS BETWEEN COMPREHENSION (COURTIS), INTELLIGENCE VOCABULARY, AND ORGANIZATION ABILITIES

	Courtis Comp.		Terman Gr.		Vis. Vocab.	
	r	P.E.	r	P.E.	r	P.E.
Terman Gr.	.709	.067				
Th. Vis. Vocab.	.536	.096	.547	.095		
Organization	.566	.092	.754	.058	.387	.112

* Hereafter in the study it will be understood that when comprehension is mentioned it means the particular ability measured by either Monroe, Thorndike-McCall, Burgess, or Courtis; intelligence means the particular ability measured by the Terman Test; vocabulary means the ability measured by the Thorndike Visual Vocabulary test; and organization means the ability measured by the Greene Organization Test.

The zero order correlations indicate that, as a basis for prediction in comprehension, intelligence comes first, vocabulary second, and organization third. The tables also show a rather significant relationship between general intelligence and vocabulary and also between intelligence and organization.

These results raise an important question as to what the true relationship between comprehension ability and vocabulary ability or organization ability is, when freed from the common factor, intelligence. How far is the correlation between comprehension and vocabulary or between comprehension and organization due to the correlation that exists between each of these and intelligence, and to what extent is it independent of the latter?

To find the answer to this, reference was made to the method of Partial Coefficients of Correlation. By this method,* if three mental abilities are correlated with one another, one can find out how closely any two of them are correlated, for a constant value of the third.

The formula used when only three abilities are in question, as above, is as follows:

$$r_{12 \cdot 3} \text{ equals } \frac{r_{12} - r_{13} r_{23}}{\sqrt{1 - r_{13}^2}\ \sqrt{1 - r_{23}^2}}$$

in which $r_{12 \cdot 3}$ is the correlation between traits 1 and 2, for a constant value of trait 3.

When this formula was applied to the foregoing correlations, the relationship between the abilities compared was different, as shown in the following tables:

TABLE 29

CORRELATIONS BETWEEN COMPREHENSION, INTELLIGENCE, AND VOCABULARY, WHEN ONE OF THE THREE IS RENDERED CONSTANT

$r_{MV.I}$	.138	$r_{MI.V}$	.498	$r_{VI.M}$	.401
$r_{TV.I}$	.501	$r_{TI.V}$	.741	$r_{VI.T}$	—.056
$r_{BV.I}$	.292	$r_{BI.V}$	.863	VI.B	.066
$r_{OV.I}$	.251	$r_{CI.V}$	.586	$r_{VI.C}$	.280

CORRELATIONS OF ZERO ORDER BETWEEN THE ABILITIES SHOWN ABOVE

r_{MV}	.425	r_{MI}	.609	r_{VI}	.547
r_{TV}	.689	r_{TI}	.827	r_{VI}	.547
r_{BV}	.599	r_{BI}	.906	r_{VI}	.547
r_{OV}	.536	r_{CI}	.709	r_{VI}	.547

* For a complete discussion of this method see Brown and Thomson, "Essentials of Mental Measurement," pp. 105, 106, and 144-148. See also Yule, *An Introduction to the theory of Statistics,* Chap. XII.

In the above table, the following letters indicate the abilities as measured by the accompanying tests:

M—Monroe Comprehension
T—Thorndike-McCall Reading
B—Burgess Silent Reading
C—Courtis Silent Reading (Number of questions correct)
I—Terman Group Intelligence
V—Thorndike Visual Vocabulary

TABLE 30

CORRELATIONS BETWEEN COMPREHENSION, INTELLIGENCE, AND ORGANIZATION, WHEN ONE OF THE THREE IS RENDERED CONSTANT

$r_{MO.I}$	—.401	$r_{MI.O}$	.661	$r_{IO.M}$	.683
$r_{TO.I}$	.028	$r_{TI.O}$	.681	$r_{IO.T}$	.556
$r_{BO.I}$	—.483	$r_{BI.O}$	.896	$r_{IO.B}$	.722
$r_{CO.I}$	.003	$r_{CI.O}$	.503	$r_{IO.C}$	.607

CORRELATIONS OF ZERO ORDER BETWEEN THE ABILITIES SHOWN ABOVE

r_{MO}	.250	r_{MI}	.609	r_{IO}	.754
r_{TO}	.613	r_{TI}	727	r_{IO}	.754
r_{BO}	.549	r_{BI}	.906	r_{IO}	.754
r_{CO}	.566	r_{CI}	.709	r_{IO}	.754

In the above table, the following letters indicate the abilities as measured by the accompanying tests:

M—Monroe Comprehension
T—Thorndike-McCall Reading
B—Burgess Silent Reading
C—Courtis Silent Reading (Number of questions correct)
I—Terman Group Intelligence
O—Greene Organization

TABLE 31

CORRELATIONS BETWEEN COMPREHENSION, VOCABULARY, AND ORGANIZATION WHEN ONE OF THE THREE IS RENDERED CONSTANT

$r_{MV.O}$	.368	$r_{MO.V}$	.102	$r_{VO.M}$	.314
$r_{TV.O}$	.620	$r_{TO.V}$	.519	$r_{VO.T}$	—.062
$r_{BV.O}$	.495	$r_{BO.V}$	.416	$r_{VO.B}$	.085
$r_{CV.O}$	.417	$r_{CO.V}$	.474	$r_{VO.C}$	.136

CORRELATIONS OF ZERO ORDER BETWEEN THE ABILITIES SHOWN ABOVE

r_{MV}	.425	r_{MO}	.250	r_{VO}	.387
r_{TV}	.689	r_{TO}	.613	r_{VO}	.387
r_{BV}	.599	r_{BO}	.549	r_{VO}	.387
r_{CV}	.536	r_{CO}	.566	r_{VO}	.387

In the above table, the following letters indicate the abilities as measured by the accompanying tests:

M—Monroe Comprehension
T—Thorndike-McCall Reading
B—Burgess Silent Reading
C—Courtis Silent Reading (Number of questions correct)
V—Thorndike Visual Vocabulary
O—Greene Organization

A study of Table 29 reveals the fact that a significant positive correlation still remains between vocabulary ability and ability in comprehension when the effects of intelligence have been eliminated. One such correlation is as high as .501, which, according to Rugg's suggestion as to the interpretation of coefficients of correlation would be "marked."* Again the correlation between ability in comprehension and ability as shown in general intelligence, with vocabulary rendered constant, is consistently "high" in every instance. On the other hand, when comprehension is rendered constant, the correlation between vocabulary ability and intelligence is generally "insignificant," hovering around zero in two of the cases, and showing "marked" correlation in only one instance when it reaches .401. By comparing the lower half of the table with the upper half, one can see the extent to which the correlation is lowered by eliminating the effects of one of the factors. From this table the following generalizations may be drawn: (1) that intelligence accounts for part, but not all of the correlation that exists between vocabulary and comprehension; (2) that vocabulary enters into the correlation between comprehension and intelligence, but to a lesser degree; and (3) that comprehension accounts largely for the correlation that is found between intelligence and vocabulary.

Table 30 is similar to Table 29 except that ability in organization was substituted for vocabulary. The correlations between the measures of comprehension and organization when intelligence is assigned are lowered appreciably, two of them being near zero, and two —.4. This absence of correlation is further shown by the fact that the correlations between comprehension and intelligence when organization is rendered constant and those between intelligence and organization with comprehension assigned are practically as high as in the zero order correlations. This situation raises some questions that within the limits of the present study cannot be definitely answered. Does it mean that the test chosen to measure organization does not measure that particular type of organization usually thought of in connection with comprehension? Or, granting that it does, is organization ability of no importance in predicting comprehension? This latter

* See Rugg, "High and Low Correlations" in his *Statistical Methods Applied to Education*, pp. 256-257. See also *Twenty-First Year Book, National Society for the Study of Education*, Part I, p. 63.

idea is contrary to the opinion of those writers quoted in Chapter II.

The conclusions drawn from Tables 29 and 30 are valid in interpreting Table 31. Here, when vocabulary is correlated with comprehension, with organization assigned, the coefficient of correlation remains nearly as high as in the zero order correlations. The same is true with comprehension and organization with vocabulary rendered constant. When comprehension is assigned, the correlation between vocabulary and organization is insignificant. The reason that the correlation between comprehension and either vocabulary or organization, when one of the latter is rendered constant, remains high may be due to the influence of intelligence. What would be the correlation between comprehension and vocabulary, or between comprehension and organization, with both intelligence and either organization or vocabulary assigned?

This question can be answered by computing the second order correlations. This was done using Thorndike-McCall as a measure of comprehension. The results are shown in Table 32.

TABLE 32

SECOND ORDER CORRELATIONS BETWEEN COMPREHENSION (THORNDIKE-MCCALL) VOCABULARY, INTELLIGENCE, AND ORGANIZATION

$r_{TV.IO}$	.505	$r_{VI.TO}$	—.026
$r_{TI.VO}$	.662	$r_{VO.TI}$	—.038
$r_{TO.VI}$	—.007	$r_{IO.TV}$	.555

This table reaffirms the conclusion drawn above: intelligence and vocabulary are significant in predicting comprehension, while organization is not. This fact is further emphasized when the regression equations are obtained. Following Yule's equation*

$$(1) \quad x_1 = b_{12\cdot34}\ x_2 - b_{13\cdot24}\ x_3\ b_{14\cdot23}$$

where $b_{12\cdot32}$ etc., are coefficients of regression, we get:

$$(2) \quad \begin{aligned} u_1 &= .631u_2 + .553u_3 - .006u_4 && (1)\\ u_2 &= .438u_1 - .019u_3 - .022u_4 && (2)\\ u_3 &= .694u_1 - .034u_2 + .462u_4 && (3)\\ u_4 &= -.010u_1 - .056u_2 + .666u_3 && (4) \end{aligned}$$

where u stands for the University Elementary School and the subscripts (1, 2, ,3 4) for comprehension, vocabulary, intelligence, and organization respectively.

* See Yule, G. Udney, *An Introduction to the Theory of Statistics*, pp. 242-249.

In equation (1) vocabulary and intelligence should be given some weight in predicting comprehension, while organization is a negligible factor. That is u_4 does not aid in estimating u_1, because $r_{TO.VI}$ is approximately equal to zero. (Yule, p. 237) These equations should be interpreted with reference to the standard error of the regression coefficient for a normal distribution. Again referring to Yule, we have:

$$\text{Standard error of } b_{12.k} \text{ for a normal distribution} = \frac{\sigma_{1.2k}}{\sigma_{2.k}\sqrt{n}}$$

where k denotes any collection of secondary subscripts other than 1 or 2. Hence we have the following:

$b_{TV.IO} = .631 \pm .236$ $\quad$ $b_{VI.TO} = -.018 \pm .146$
$b_{VT.IO} = .428 \pm .169$ $\quad$ $b_{IV.TO} = -.034 \pm .263$
$b_{TI.VO} = .553 \pm .179$ $\quad$ $b_{VO.TI} = -.022 \pm .121$
$b_{IT.VO} = .694 \pm .223$ $\quad$ $b_{OV.TI} = -.056 \pm .316$
$b_{TO.VI} = -.006 \pm .152$ $\quad$ $b_{IO.TV} = .462 \pm .166$
$b_{OT.VI} = -.010 \pm .266$ $\quad$ $b_{OL.TV} = .666 \pm .240$

where $b_{TV.IO}$ is the regression of vocabulary on comprehension when intelligence and organization are rendered constant, etc. Thus, while the standard error is large owing to the small number of cases involved, the regressions of vocabulary and intelligence on comprehension are large enough to predict comprehension for the group in terms of vocabulary and intelligence. Such a prediction for an individual must await further investigation.

By using the following equation, one can compute the correlation between x_1 and the expression on the right-hand side of equation (1). The same holds true for equations (2), (3), and (4).

$$R_{1\,(234)} = \frac{\sqrt{\sigma_1^2 - \sigma_{1.234}^2}}{\sigma_1}$$

where 1 and 1.234 are the zero and third order standard deviations respectively. These data are useful in indicating how closely x_1 can be expressed in terms of a linear function of x_2, x_3, and x_4; and the values of the regressions may be regarded as determined by the condition that R shall be a maximum.* When this is done we have the following values for R for equations (1) to (4) above:

* See Yule, G. Udney, *An Introduction to the Theory of Statistics*, pp. 247, 248.

(a) $R_{T(VIO)} = .87$
(b) $R_{V(TIO)} = .63$
(c) $R_{I(TVO)} = .94$
(d) $R_{O(TVI)} = .76$

From this it follows that although these correlations are high, they all fall below unity. Other factors than those considered must enter to make the difference.

SECTION B

The results of Section A were obtained from experimentation with twenty-five children in the University Elementary School. In this school silent reading is given a great deal of emphasis. The teachers are perhaps better trained and the equipment in reading material is much more extensive and varied than in the ordinary public schools. In addition to this the projects undertaken in the school call for much silent reading. Because of the existence of these conditions, one may ask if the findings in this group apply to schools as they are found generally throughout the country. Does the fact that these children are pushed in their reading operate to give results that are different from those found in the public schools?

In order to check the results of the previous section, tests covering intelligence, vocabulary and organization were given to 136 fifth grade pupils in four schools of Cedar Rapids, Iowa. Table 33 shows inter-correlation between each of these tests and comprehension as measured by the Thorndike-McCall reading test. For convenience of comparison, the similar inter-correlations for the University Elementary School are included.

TABLE 33

INTER-CORRELATIONS BETWEEN SCORES ON TESTS GIVEN TO FIFTH GRADE PUPILS OF FOUR CEDAR RAPIDS, IOWA, PUBLIC SCHOOLS, AND THE UNIVERSITY ELEMENTARY SCHOOL

	Thorndike-McCall		Terman		Vis. Vocab.	
	r	P.E.	r	P.E.	r	P.E.
I. Johnson School (20 pupils)						
Terman Group	.459	.119				
Vis. Vocab.	.069	.149	.069	.149		
Greene Organ.	.264	.140	.397	.127	.083	.149
II. Buchanan School (24 pupils)						
Terman Group	.683	.070				
Vis. Vocab.	.694	.069	.696	.068		
Greene Organ.	.409	.110	.681	.071	.632	.079

III. Jackson School (40 pupils)						
Terman Group	.615	.066				
Vis. Vocab.	.506	.079	.645	.062		
Greene Organ.	.189	.102	.339	.094	.361	.094
IV. Polk School (50 pupils)						
Terman Group	.542	.067				
Vis. Vocab.	.481	.074	.604	.060		
Greene Organ.	.330	.086	.364	.083	.403	.079
V. University Elementary School (25 pupils)						
Terman Group	.827	.041				
Vis. Vocab.	.689	.071	.547	.095		
Greene Organ.	.613	.084	.754	.058	.387	.112

The correlations for the four Cedar Rapids schools are somewhat lower than are those of the University Elementary School. Nevertheless the correlations obtained from the different abilities tested remain in the same relationship to each other as in the University school study. Therefore they may be interpreted in the same way, *i.e.*, that as a basis for prediction in comprehension, intelligence comes first, vocabulary second, and organization third.

In order to determine the relationships existing when one or two of the abilities have been rendered constant, the first and second order correlations, the second order regressions, the regression equations of the second order, and the correlation R (where R is the correlation between the two sides of the regression equation) were computed. These are found in the tables that follow.

TABLE 34

ZERO, FIRST AND SECOND ORDER CORRELATIONS BETWEEN COMPREHENSION (THORNDIKE-McCALL), VOCABULARY, INTELLIGENCE AND ORGANIZATION. JOHNSON SCHOOL, CEDAR RAPIDS, IOWA, GRADE V (20 PUPILS)

Zero Order	First Order	Second Order
$r_{TV} = .069$	$r_{TV.O} = .049$	$r_{TV.IO} = .040$
$r_{TI} = .459$	$r_{TI.O} = .404$	$r_{TI.VO} = .385$
$r_{VI} = .069$	$r_{VI.O} = .039$	$r_{VI.TO} = .045$
$r_{TV} = .069$	$r_{TV.I} = .047$	$r_{TV.IO} = .040$
$r_{TO} = .264$	$r_{TO.I} = .146$	$r_{TO.VI} = .099$
$r_{VO} = .083$	$r_{VO.I} = .061$	$r_{VO.TI} = .206$
$r_{TI} = .459$	$r_{TI.V} = .454$	$r_{TI.VO} = .385$
$r_{TO} = .264$	$r_{TO.V} = .260$	$r_{TO.VI} = .099$
$r_{IO} = .397$	$r_{IO.V} = .393$	$r_{IO.TV} = .319$
$r_{VI} = .069$	$r_{VI.T} = .042$	$r_{VI.TO} = .045$
$r_{VO} = .083$	$r_{VO.T} = .260$	$r_{VO.TI} = .260$
$r_{IO} = .397$	$r_{IO.T} = .322$	$r_{IO.TV} = .319$

TABLE 35

ZERO, FIRST AND SECOND ORDER CORRELATIONS BETWEEN COMPREHENSION, VOCABULARY, INTELLIGENCE, AND ORGANIZATION, BUCHANAN SCHOOL, CEDAR RAPIDS, IOWA, GRADE V, (26 PUPILS)

Zero Order	First Order	Second Order
$r_{TV} = .694$	$r_{TV.O} = .616$	$r_{TV.IO} = .433$
$r_{TI} = .683$	$r_{TI.O} = .605$	$r_{TI.VO} = .403$
$r_{VI} = .696$	$r_{VI.O} = .468$	$r_{VI.TO} = .148$
$r_{TV} = .694$	$r_{TV.I} = .418$	$r_{TV.IO} = .433$
$r_{TO} = .409$	$r_{TO.I} = -.105$	$r_{TO.VI} = .264$
$r_{VO} = .632$	$r_{VO.I} = .300$	$r_{VO.TI} = .382$
$r_{TI} = .683$	$r_{TI.V} = -.386$	$r_{TI.VO} = .403$
$r_{TO} = .409$	$r_{TO.V} = -.053$	$r_{TO.VI} = -.264$
$r_{IO} = .681$	$r_{IO.V} = .433$	$r_{IO.VT} = .492$
$r_{VI} = .696$	$r_{VI.T} = .420$	$r_{VI.TO} = .148$
$r_{VO} = .632$	$r_{VO.T} = .530$	$r_{VO.TI} = .382$
$r_{IO} = .681$	$r_{IO.T} = .603$	$r_{IO.TV} = .492$

TABLE 36

ZERO, FIRST AND SECOND ORDER CORRELATIONS BETWEEN COMPREHENSION (THORNDIKE-MCCALL), VOCABULARY, INTELLIGENCE, AND ORGANIZATION, JACKSON SCHOOL, CEDAR RAPIDS, IOWA, GRADE V, (40 PUPILS)

Zero Order	First Order	Second Order
$r_{TV} = .506$	$r_{TV.O} = .468$	$r_{TV.IO} = .190$
$r_{TI} = .615$	$r_{TI.O} = .596$	$r_{TI.VO} = .441$
$r_{VI} = .645$	$r_{VI.O} = .596$	$r_{VI.TO} = .441$
$r_{TV} = .506$	$r_{TV.I} = .181$	$r_{TV.IO} = .190$
$r_{TO} = .189$	$r_{TO.I} = .026$	$r_{TO.VI} = -.064$
$r_{VO} = .361$	$r_{IO.V} = .198$	$r_{VO.TI} = .205$
$r_{TI} = .615$	$r_{TI.V} = .438$	$r_{TI.VO} = .441$
$r_{TO} = .189$	$r_{TO.V} = .088$	$r_{TO.VI} = .064$
$r_{IO} = .339$	$r_{IO.V} = .149$	$r_{IO.TV} = .162$
$r_{VI} = .645$	$r_{VI.T} = .491$	$r_{VI.TO} = .441$
$r_{VO} = .361$	$r_{VO.T} = .313$	$r_{VO.TI} = .205$
$r_{IO} = .336$	$r_{IO.T} = .288$	$r_{IO.TV} = .162$

TABLE 37

ZERO, FIRST AND SECOND ORDER CORRELATIONS BETWEEN COMPREHENSION (THORNDIKE-McCALL), VOCABULARY, INTELLIGENCE, AND ORGANIZATION POLK SCHOOL, CEDAR RAPIDS, IOWA, GRADE V, (50 PUPILS)

Zero Order	First Order	Second Order
$r_{TV} = .481$	$r_{TV.O} = .216$	$r_{TV.IO} = .181$
$r_{TI} = .542$	$r_{TI.O} = .480$	$r_{TI.VO} = .347$
$r_{VI} = .604$	$r_{VI.O} = .536$	$r_{VI.TO} = .415$
$r_{TV} = .481$	$r_{TV.I} = .229$	$r_{TV.IO} = .181$
$r_{TO} = .330$	$r_{TO.I} = .188$	$r_{TO.VI} = .119$
$r_{VO} = .403$	$r_{VO.I} = .247$	$r_{VO.TI} = .186$
$r_{TI} = .542$	$r_{TI.V} = .366$	$r_{TI.VO} = .347$
$r_{TO} = .330$	$r_{TO.V} = .170$	$r_{TO.VI} = .119$
$r_{VO} = .364$	$r_{IO.V} = .165$	$r_{IO.TV} = .243$
$r_{VI} = .604$	$r_{VI.T} = .466$	$r_{VI.TO} = .416$
$r_{VO} = .403$	$r_{VO.T} = .295$	$r_{VO.TI} = .186$
$r_{IO} = .364$	$r_{IO.T} = .295$	$r_{IO.TV} = .243$

TABLE 38

SECOND ORDER REGRESSIONS, COEFFICIENTS, AND STANDARD ERRORS FOR THE SAME, FOUR CEDAR RAPIDS, IOWA, SCHOOLS, GRADE V

	Johnson	Buchanan	Jackson	Polk
$b_{TV.IO}$	.397 ± .219	.550 ± .247	.252 ± .210	.257 ± .200
$b_{VT.IO}$	.411 ± .227	.341 ± .154	.143 ± .119	.127 ± .099
$b_{TI.VO}$	.293 ± .170	.512 ± .247	.452 ± .161	.398 ± .148
$b_{IT.VO}$	.505 ± .294	.317 ± .154	.432 ± .155	.304 ± .123
$b_{TO.VI}$	.078 ± .175	.252 ± .187	—.054 ± .133	.062 ± .125
$b_{OT.VI}$	.127 ± .284	.278 ± .205	.076 ± .189	.133 ± .159
$b_{VI.TO}$	—.035 ± .173	.148 ± .195	.340 ± .121	.335 ± .105
$b_{IV.TO}$	—.059 ± .289	.148 ± .195	.573 ± .206	.514 ± .175
$b_{VO.TI}$	.209 ± .178	.286 ± .147	.131 ± .100	.117 ± .088
$b_{OV.TI}$	.326 ± .279	.509 ± .260	.326 ± .249	.296 ± .225
$b_{IO.TV}$	.330 ± .231	.369 ± .147	.134 ± .130	.189 ± .110
$b_{OI.TV}$	.309 ± .223	.656 ± .260	.196 ± .190	.312 ± .166

TABLE 39

COMPARISON BETWEEN THE REGRESSION EQUATIONS OF THE FIVE SCHOOLS

$$u_1 = .631u_2 \pm .553u_3 - .006u_4$$
$$j_1 = .397j_2 \pm .293j_3 + .078j_4$$
$$b_1 = .550b_2 \pm .512b_3 - .252b_4$$
$$ja_1 = .252ja_2 \pm .452ja_3 + .054ja_4$$
$$p_1 = .257p_2 \pm .398p_3 + .062p_4$$

$$u_2 = .438u_1 - .019u_3 - .022u_4$$
$$j_2 = .411j_1 - .035j_3 + .209j_4$$
$$b_2 = .341b_1 + .148b_3 + .286b_4$$
$$ja_2 = .143ja_1 + .341ja_3 + .131ja_4$$
$$p_2 = 127p_1 + .335p_3 + .117p_4$$

$$u_3 = .694u_1 - .034u_2 + .462u_4$$
$$j_3 = .505j_1 - .059j_2 + .330j_4$$
$$b_3 = .317b_1 + .148b_2 + .369b_4$$
$$ja_3 = .432ja_1 + .574ja_2 + .134ja_4$$
$$p_3 = .304p_1 + .514p_2 + .189p_4$$

$$u_4 = -.010u_1 - .056u_2 + .666u_3$$
$$j_4 = .127j_1 + .326j_2 + .309j_3$$
$$b_4 = -.278b_1 + .509b_2 + .656b_3$$
$$ja_4 = -.076ja_1 + .326ja_2 + .196ja_3$$
$$p_4 = .133p_1 + .296p_2 + .312p_3$$

In the above table, u, j, b, ja, and p, are used for University Elementary, Johnson, Buchanan, Jackson, and Polk schools respectively; the subscripts 1, 2, 3, and 4 refer to the Thorndike-McCall, Thorndike Visual Vocabulary, Terman Group Intelligence, and Greene Organization respectively.

TABLE 40

CORRELATIONS BETWEEN THE TWO SIDES OF THE REGRESSION EQUATIONS FOR EACH OF THE FIVE SCHOOLS

	U. Elem.	Johnson	Buchanan	Jackson	Polk
$R_{T(VIO)}$ =	.87	.57	.77	.82	.87
$R_{V(TIO)}$ =	.63	.44	.78	.70	.41
$R_{I(TVO)}$ =	.94	.65	.81	.73	.88
$R_{O(TVI)}$ =	.76	.42	.74	.40	.75

The zero order, first order, and second order correlations for the four Cedar Rapids schools correspond closely enough to those of the University Elementary School to allow the same interpretation to be drawn: that of the factors in comprehension under consideration, intelligence and vocabulary play by far the largest part. The Johnson school shows an apparent contradiction. But in this school there were only twenty cases and the probable errors are so large that the correlations are of less value. The second

order regressions, coefficients, and the regression equations (Tables 38 and 39) point to the conclusion stated above.

Table 40 shows the values of $R_{T(VIO)}$, $R_{V(TIO)}$, $R_{I(TVO)}$, and $R_{O(TVI)}$ for the five schools under consideration. With the exception of the Johnson school, there is quite general agreement among these correlations. The difference between these correlations and unity indicates that there are other factors outside the limits of this study which are a part of ability in compresenion. But whatever these factors are, the present study indicates that the teacher who recognizes the part played by intelligence and vocabulary will have the foundation for developing efficiency in comprehension. The former is not amenable to training, but the teacher should make sure by every means at hand that each child is pushed as far as his intelligence will allow. However, vocabulary is subject to training, and the principal result of this study is that training in vocabulary will aid the comprehension of an individual as far as his intelligence will permit.

In conclusion, while the results of this study point to the importance of intelligence and vocabulary as factors in comprehension, the writer is not unmindful of the fact that success here as in other phases of school work depends also upon such other factors as faithful attendance, good health, good home environment, persistent effort, maturity, an enriched course of study, and well-trained, efficient teachers. The advancement of a pupil will depend on how fortunate he is in each of these respects, and the lack of any one of them may retard him materially.

CHAPTER IV

SUMMARY AND CONCLUSIONS

In the analysis of an ability as complex and obscure as comprehension, many difficulties are apparent. But with the application of scientific methods and extended experimentation these difficulties will be surmounted and the knowledge so gained can be utilized to render future development more certain and efficient. If teachers know the types of difficulty that underlie such an ability and are aware of types of training that will insure the formation of desirable habits and the breaking down of all habits that hinder or depress efficient comprehension, this knowledge can be applied to individual pupils to find and remedy their particular needs.

The minimum requirements for efficient comprehension are being determined at present by utilizing the results of standard tests in reading. When, by means of these tests, a pupil is discovered to be below the normal for his age or grade, the immediate problem of the teacher is to discover what difficulties are present and to correct them if possible.

This study was undertaken with the hope of discovering the importance of factors said to operate in comprehension of silent reading. The following summary gives the results obtained:

1. A survey of the field of educational literature gave twelve prominent factors as possible causes of difficulty in comprehension.
    a. Low general intelligence
    b. Insufficient vocabulary
    c. Faulty rate of reading
    d. Lip movements and articulation
    e. Poor environment
    f. Too little reading practice
    g. Poor school attendance
    h. Small recognition span
    i. Lack of motivation
    j. Lack of organization ability

k. Inability to reproduce
l. Inability to reason

2. Six of the above factors were rejected in this study because the technique for isolating them at present was not obtainable. The six retained were:
   a. Intelligence
   b. Vocabulary
   c. Organization
   d. Rate
   e. Reproduction
   f. Lip movements
3. Comparisons between the scores on comprehension tests and measures of the six factors given above show positive relationship between all of them.
4. The zero order correlations reaffirm this relationship and show the following order of importance among them:*
   a. Intelligence
   b. Vocabulary
   c. Organization
   d. Rate
   e. Reproduction
5. The first and second order correlations and the regression equations of the second order lessen the importance of organization as a factor in comprehension.†
6. The correlations between comprehension on the one hand and the combined effect of intelligence, vocabulary, and organization on the other for three of the five schools included are above .80.
7. Every method of comparison used in this study reveals intelligence and vocabulary as far outranking all the other factors studied in their effect upon comprehension. The effects of rate, reproduction, and organization can probably be explained through the factor of general intelligence. Intelligence is supposed not to be subject to improvement through training. The main suggestion to be made in connection with this point is that the teacher endeavor to push each child to the limit of his intelligence. Vocabulary, however, may be easily

* The measure of lip movement was such that correlations could not be made from it.

† Rate and reproduction were eliminated from the statistical treatment given to the other three factors because their zero order correlations were less significant and their probable errors large.

and extensively improved through properly motivated training; and in the opinion of the author this type of training is at present our surest means of developing efficient comprehension in silent reading.

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